Brebner Flat

Fire/Fuels/Air Quality Report

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for:

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Introduction

The availability of fuels and their arrangement play a key role in how fire burns. Fuels influence firefighting tactics and dictate many of fire's effects on natural resources and air quality. The **silvicultural treatments** being proposed with the Brebner Flat project affect fuels through changes in the structure, function, and composition of timber stands. **Road management activities** such as construction and decommissioning will be addressed, as they affect fire suppression and other fire management activities. **Prescribed fire** can be utilized to accomplish specific objectives, such as slash disposal, site preparation for tree planting, and hazardous fuels reduction. Such reduction in fuels is especially important to firefighter and public safety in the event of a wildfire in the Wildland Urban Interface (WUI), or in other areas where fire is suppressed due to values at risk.

The Brebner Flat project proposes commercial harvest on 1719 acres of Forest Service land, along with associated road construction, slash burning, and tree planting that would influence fire and fuels management in the future.

Table 1. Alternative Summary

Treatment/Activity	Alternative A (No Action)	Alternative B (Prop Action)
Silvicultural Treatments (Acres)		
Clearcut Harvest (with reserves)	0	618 acres
Seed Tree (with reserves)	0	273 acres
Irregular Shelterwood/Seed Tree (with reserves)	0	260 acres
Irregular Shelterwood (with reserves)	0	568 acres
Total Commercial Harvest	0	**1719 acres**
Logging Systems		
Ground-based	0	582 acres
Skyline	0	898 acres
Off-road Skyline	0	239 acres
Post-Harvest Vegetation Treatment		
Yard Tops	0	1686 acres
Grapple Pile and Burn	0	582 acres
Broadcast Burning	0	1137 acres
Road Management		
New Road Construction	0 mi	2.05 mi
Temporary Road Construction	0 mi	4.04 mi
Road Re-Construction	0 mi	2.96 mi

Overview of Issues Addressed

This analysis will focus on how the project alternatives are expected to affect the behavior of potential wildfires, including fire size and severity; and how fire behavior relates to decisions regarding firefighter and public safety. Specifically, we will look at the condition of forest fuels in all layers (**surface fuels, ladder fuels,** and **canopy fuels**), as well as across the project area in terms of continuity.

Fire Behavior Indicators

Three primary fire behavior indicators were used to evaluate changes expected with the alternatives. First, **flame length** (which is related to fuel loading and arrangement) was used to determine **surface fire** behavior potential, considering current and possible stand conditions. Suppression tactics are directly related to flame lengths. For example, flame lengths less than four feet can be effectively attacked using hand crews constructing direct fire line, while flame lengths greater than four feet will likely have to be attacked using dozers, engines, and aircraft (NWCG Fireline Handbook 2006, page B-59). Flame length in this case refers to surface flames only, not those produced by fire in the crowns of trees.

The second indicator is called **probability of torching**. The probability of torching considers the proportion of the stand where there are enough **ladder fuels** for fire to climb up into the trees (Crookston and Reinhardt, 2003). Tree crowns of large trees are ignited by the flames of a surface fire or flames from burning crowns of small trees that reach the larger trees.

Crown fuels are measured with the **crowning index**, which is the wind speed 20 feet above the canopy at which active crowning is possible (Scott and Reinhardt 2001, p. 17). The crowning index reflects the density of **canopy fuels**. Active crown fire, also called a running or continuous crown fire, is one in which the entire surface/canopy fuel complex becomes involved, but the crowning phase remains dependent on heat from the surface fuels for continued spread. The higher the crowning index, the lower the crown fuel loading and the lower the crown fire hazard.

Figure 1. Surface fuels in proposed Brebner Flat unit.

Figure 2. Ladder fuels in proposed Brebner Flat unit.

Hazardous Fuels Reduction and Canopy Opening Sizes

There is a need to reduce hazardous fuels to lessen the threat of wildland fire, and to allow for safer and more effective fire management in the Brebner Flat project area. This is the desired condition for fuels in the Wildland Urban Interface (WUI) according to guideline MA6-GDL-FIRE-01 in the 2015 Land Management Plan for the IPNF. The town of Avery, as well as the main ingress/egress road along the St. Joe River for residents and first responders in the event of an emergency, lie along the north boundary of the project area. Shoshone County has identified this as an area of concern in their Community Wildfire Protection Plan (PF#1, CWPP doc.). In addition to the town of Avery, there are approximately four sections of privately-owned timber mixed with the public timberland in the Brebner Flat project area. These sections are in various stages of timber production, and valued by their owners for commercial value now and into the future. The existing condition across the project area varies from mature timber to young stands of smaller trees (less than 30 years old). The proposed action would meet this fuel treatment need through timber harvest, removal, and slash burning. Studies incorporating analytical and empirical data show that fuels treatments involving both thinning (removal of vegetation) and burning are most-effective in reducing wildfire severity (Kalies and Kent, 2016). Additional opportunities for treatment of fuels in the project area, including natural fuels burning and mechanical treatment, were considered during project development. Due to cumulative effects and scenery concerns, as well as probability of meeting objectives due to fuel types and location, these options were removed from consideration (PF#11).

The proposed action would create some openings that are larger than 40 acres in size. These relatively large openings create a more heterogeneous pattern across the landscape and reduce potential wildfire activity by breaking up fuel continuity. Fire behavior and severity depend on fuel properties like fuel continuity (Graham et al. 2004). Continuous aerial extent of closed canopy contributes to sustained crown fire once initiated (Scott and Reinhardt 2001). The larger the openings the more effective treatment areas are for suppression resources to engage the fire more safely and under more severe conditions. Smaller areas are subject to increased risk of spotting as there is less distance for embers to travel to reach receptive fuels (Weatherspoon and Skinner 1996, Van Wagtendonk 1996).

Regeneration harvest of units greater than 40 acres in size create more slash in the short term than either of the other alternatives, but design features and compliance with the Idaho Forest Practices Act would hasten treatment of the slash, resulting in larger openings with less fuel available to wildfire. These larger harvest units not only create fuel breaks, but promote growth of more fire-resistant tree species in the longer term. The proposed action includes large openings that meet the purpose and need to promote forest conditions that reduce the risk of wildfire to National Forest System lands.

Affected Environment

Existing Condition

Project Area Description

The Brebner Flat project area encompasses close to 11,800 acres of mixed-ownership land just south of the St. Joe River and Avery, Idaho. Main watercourses are Roundhouse Gulch, Kelley Creek, Blue Grouse Creek, and Siwash Creek. Forest Service land in the area is checker-boarded in with entire sections owned by private timber companies. This industrial timber ground is in various stages of production: from high-dollar mature timber, to plantations, to recently-harvested acreage where piles of slash remain. Along the St. Joe River for one mile at the mouth of Kelley Creek is private property with residences and other structures and improvements. The north portion of the Brebner Flat project area is classified as WUI by Shoshone County due to the proximity of the town of Avery. Elevations range from 3000-5500 feet. The area is categorized as an “inland maritime” climate, and precipitation averages 30-40 inches annually, primarily occurring during winter and spring months. Upriver from Avery, a half-mile-wide strip along the river is classified as Wild and Scenic-Recreational. In this area, north-facing slopes are steep (50%-70%), and vegetation is primarily cedar, grand fir, and riparian; however, some western larch turned autumn gold can be seen in the following photo.

Figure 3. Part of the Brebner Flat Project Area that is classified as Wild and Scenic River as viewed from Upper Landing picnic area just upriver from Avery.

Fuel Characteristics

Fire Groups

A Fire Group is a cluster of habitat types within a given geographic area; all habitat types in a fire group have similar pre-settlement fire regimes, similar response of dominant tree species to fire, and similar successional patterns. Fire groups are described to help managers understand broad patterns in the fire ecology of northern Idaho's forests (Smith and Fischer 1997).

Fire Group Seven is the primary fire group in the Brebner Flat project area. Grand fir is the climax species, with Douglas-fir an important seral species. The presence of lodgepole pine, western larch, and western white pine depends on moderate moisture conditions and favorable fire history, among other factors like insects and disease and site condition. Fire Group Seven may have the most variable fire regime in northern Idaho, ranging from low- and mixed-severity on a moderate return interval of 30 to 80 years, to less-frequent stand-replacing fires every 150 years or more (Zack and Morgan 1994). Low- and mixed-severity fires increase structural complexity within stands and heterogeneity across the landscape.

Older trees in Brebner commonly display evidence of past fire. Without low-or mixed-severity fire, Douglas-fir and grand fir increase, accompanied by increasing stress from defoliating insects and root disease. In Brebner Flat, grand fir and Douglas-fir stands in the 80-110 year age class are showing the effects of insects and root disease. Brebner Flat also has lodgepole pine stands that are experiencing ongoing mortality from the mountain pine beetle. Many remnant (older than 100 years) larch are infected with dwarf mistletoe.

Fuel Models

Fire behavior fuel models are used as input to the Rothermel (1972) fire spread model, which is used in a variety of fire behavior modeling systems. Forty dynamic fuel models were developed by Scott and Burgan in 2005 in order to improve the accuracy of fire behavior predictions from the original 13 Fuel Model categories in use since the1970s. Among other enhancements, this 40 fuel model set increased the number of fuel models for forest litter with grass or shrub understory, which is dominant in Brebner. Predicted surface fire behavior drives crown fire models, so increased precision in modeling surface fires leads to better crown fire behavior prediction and hazard assessment (Scott and Burgan 2005).

The majority of stands in Brebner Flat can be categorized as TL3 or TU5. TL3 is a moderate load conifer litter fuel type (see Figure 4). TU5 is a very high load/dry climate timber-shrub fuel type where the primary carrier of fire is heavy forest litter with a shrub or small tree understory. Spread rate and flame lengths are typically moderate. The main fuel characteristics associated with these fuel models are moderate loads of timber litter with a noticeable continuity in the larger (>3" diameter) down-woody material, especially near pockets of root disease or beetle infestation. Shrubs and grasses are generally continuous and regenerating shade-tolerant trees are abundant, contributing to the ladder fuels (fuels that provide vertical continuity between layers of vegetation).

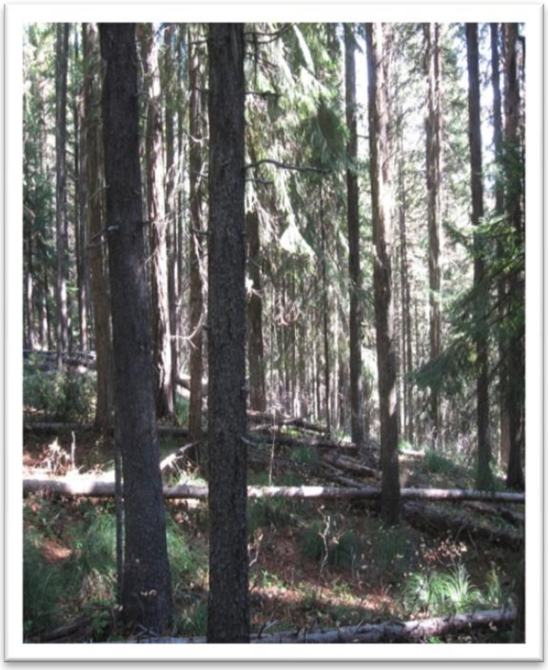

Figure 4. Example of stand in Brebner that represents a Fire Group Seven, Fuel Model TL3 (moderate load conifer litter).

Figure 5. Lodgepole pine with Mountain Pine Beetle affliction. As increased mortality occurs in stands, the amount and distribution of dead down fuels increases (surface fuel loading).

Fire Group Seven stands tend to produce heavy fuels. Most of the downed woody fuel results from accumulated deadfall and natural thinning, but grand fir also produces a relatively heavy load of twigs and small branch wood. The amount, distribution, and uniformity of dead down fuels increase as young mixed conifer stands age and progress through stem exclusion stages and seral progression. If mortality occurs rapidly and extensively enough, Fuel Model TL5 (high load conifer litter) becomes the prevalent fuel model matrix. The grand fir/Douglas-fir stands in Brebner are trending toward a Fuel Model TL5, due to the age of the stands and the pathogenic activity.

The existing condition for these dense, mature lodgepole pine and grand fir/Douglas-fir stands is outside the natural range of variability in terms of species composition, insect and disease activity, and heterogeneity in stand structure. While root diseases and mountain pine beetle are introducing heterogeneity, this agent acts differently than fire in that it is continually causing tree mortality (PF#2, NFMA Report). From a fire and fuels management standpoint, these pathogens tend to create a continuous availability of fuels to burn at the crown, ladder, and surface levels as affected trees die and fall to the forest floor at different rates. This condition can result in high rates of fire spread, flame lengths greater than four feet, and increased risk of crown fire.

The overall desired condition for fire and fuels according to the land management plan for the IPNF is firefighter and public safety. Fire-tolerant and resilient stands where wildfires burn in the surface fuels with low flame lengths allow for safer and more effective fire management where values are at risk.

Fire History

Past forest management included a wildfire exclusion policy intended to facilitate maintenance of regulated timber supplies, increased human safety, and reduced resource losses. Fire suppression efforts to date have been largely successful in holding wildfires to a small average size. The occurrence of larger fires has been reduced by aggressive initial attack of small emerging fires. Fire control, however, is unlikely to continue to be as effective because of increasing fuels, the predictable occurrence of lightning, and occasional multi-season/multi-year drought conditions. Wildfire suppression statistics of the western United States indicate that large, stand-replacing fire occurrence has greatly increased over the last 20 years (Calkin and others 2005).

Current conditions in stands that have had little or no human management are generally thought to be trending toward higher probabilities of stand-replacing fires (crown fire) than they would have prior to the influence of European settlement (Zack and Morgan 1994; Brown 2000). The reduction of low and/or mixed-severity fire occurrence, selective logging of old fire resistant trees, climatic influences, and wide spread mortality of western white pine due to blister rust have contributed to this trend (Zack and Morgan 1994). The loss of western white pine as the dominant early successional species over large areas in northern Idaho has changed the ecology of entire forest communities. As western white pine populations and reproduction have declined, grand fir has become more important in succession (Ferguson 1994). The susceptibility of grand fir to root pathogens (Haig and others 1941) reduces productivity on sites formerly dominated by western white pine and accelerates succession to climax species (Smith and Fischer 1997). This transition effects fire severity in that dead and dying trees that are afflicted with blister rust, root disease and other pathogens, tend to burn more readily than healthy green trees.

Fire Occurrence History records are available for the area for the period from 1940 to 1970 in the form of historical fire atlases. Electronic records are available for the area for the period from 1974 to present. A data gap exists for the years from 1971 to 1973. A large-fire, burned-area map covering the project area is also available in both historical and digitized (GIS) formats. The large-fire, burned-area map includes data from 1890 to present.

In the Brebner Flat area, legacy fire history data shows the fires in 1910 as affecting nearly all of the project area (PF#3). Records show only ten small fires detected from 1986 to 2015, the largest of which was contained at four acres. The remaining nine fires were an acre or less in size. The area seems to get few human fire starts, the majority of the fires on record were started by lightning (PF#4).

Prescribed fire has also been part of the fire history in the project area. On Forest Service ownership, records show that 1402 acres of broadcast burning have been accomplished from 1985-2005 as site preparation for planting and to reduce activity fuels in conjunction with past timber harvests. In addition, 1,546 acres of piles have been burned to reduce slash from these sales (PF#5). No prescribed fire records are available for private land in the project area, but observations of timber harvest activities indicate that similar practices for slash disposal have been followed on over 1,100 acres of harvest since 2003 (PF#13).

Figure 6. Blackened stump is evidence of past fire in proposed Unit 3, Brebner Flat.

Vegetative Conditions Related to Past Harvests

Through a query of the Forest Service database, it was found that 1644 acres in the project area have previously had timber harvesting and subsequent activities. Activities occurred primarily in the 1980’s and 1990’s, and consisted of a variety of silvicultural prescriptions. Forty percent were clearcuts and clearcuts with reserves, with the bulk of the remainder being shelterwood and seedtree prescriptions (PF#6). Following harvest, slash was burned as described above. Tree planting and subsequent stand improvement activities including pre-commercial thinning and pruning were performed across the sale areas. As a result, many of the stands subjected to these past activities show only a low to moderate departure from natural historic ranges in fire regimes today (PF#12 FRCC Map). A fire regime can be defined as “describing the pattern of fire seasonality, frequency, size, spatial continuity, intensity, type, and severity in a particular area or ecosystem” (Agee 1994, Mutch 1992, Johnson and Van Wagner 1985, Sugihara and others 2006). The level of departure of a stand from its historic fire regime is called the Fire Regime Condition Class (FRCC). As forests experience a high departure from their historic fire regime, the risk of losing key ecosystem components is high, invasive species may be common, and dramatic increases can occur in future fire size, intensity, and severity due primarily to an increase in fuels available to burn. It can be said that vegetative conditions, and thus fuels conditions, have improved overall in formerly harvested and re-planted stands in the project area in regards to FRCC.

Timber harvest has also occurred on much of the private land in the project area, much of it fairly recently. A total of 1128 acres have been cut since 2003, using overstory removal techniques, with less than 10% being clearcut (PF#13). It is likely that the primary method of regeneration has been through natural re-sprouting of species already present in the stands. Of primary concern to fire managers is the commercial slash created by these operations that could pose a fire hazard if not treated properly. Operations on private land must manage slash in accordance with state law as set forth in the Idaho Forestry Act (Title 38, Ch. 1 &4, Idaho Code) and the Rules Pertaining to Forest Fire Protection (IDAPA 20.04.01). Fire wardens from the Idaho Department of Lands inspect nearly 100% of forest practices on private forestlands for slash compliance (ID Forestry BMP Field Guide, 2015).

Road construction to facilitate timber harvest has occurred in the area. Road construction can affect the fuels resource in several ways. Roads create a barrier absent of fuels that can serve as a barrier to wildfire. Roads also allow fire suppression crews better access with equipment and reduce response time to wildfires. Once roads are closed and grow back in with vegetation, these effects on fuels and fire suppression diminish.

Desired Condition

Desired fuel characteristics for this project are those that contribute to surface fire behavior rather than torching and active crown fire behavior. Less intense, desired surface fire behavior generally occurs when surface fuels are light, there are minimal ladder fuels, and over-story crowns are spaced to minimize fire spread from tree to tree.

The overall goals for fire and fuels management are reduced fuels for the protection of public and firefighter safety. These goals are attained by creating forest conditions which result in slow rates of fire spread, low flame lengths (4 feet and below or the point at which ground crews can safely and directly attack a fire), and a low risk of crown fire. According to the forest plan, a desired condition is a sustainable forest system. In terms of fire management, this means fire-tolerant and resilient stands where wildfires burn in the surface fuels with low flame lengths such that life and property can be protected.

Objectives for fuel management come from the Forest Service Manual FSM 5100, 5140.2 and are as follows:

(1) Integrate fire, as a critical natural process, into land and resource management plans, and develop achievable and sustainable Land and Resource Management Plan (LRMP) objectives that provide for landscapes which are resilient to fire related disturbances and climate change.

(2) In cooperation with partners, strategically plan and implement on a landscape scale, risk-informed, and cost-effective hazardous fuel modification and vegetation management treatments to attain management objectives identified in Land and Resource Management Plans to protect, sustain, and enhance resources and, where appropriate, emulate the ecological role of natural fire.

These objectives correlate closely with desired conditions stated in the Idaho Panhandle National Forests Land Management Plan. Public and firefighter safety is always recognized as the first priority for all fire management activities (USDA IPNF Forest Plan, 2015. FW-DC-FIRE-01).

Shoshone County, Idaho has identified the area in and around Avery, Idaho as Wildland Urban Interface (WUI). The Brebner Flat project area intersects with this WUI for 5623 acres. The Forest Plan states a desired condition for hazardous fuels to be reduced in WUI (GA-DC-FIRE-SJ-01). A combination of timely slash management and silvicultural practices that include planting of species such as western larch will lead to a stand that is more resilient to torching and active crown fire behavior.

Environmental Consequences

Methodology

Analysis for this report is based on vegetation data collected during the most-recent stand exams (2013-14) using Forest Service Common Stand Exam protocols (PF#7). Fire Group, based on Fire Ecology of the Forest Habitat Types of Northern Idaho (Smith and Fischer, 1997), was determined through professional judgement while reviewing the stand information and photographs. Forest Service databases were queried to obtain fire history in the project area, as well as information pertaining to other past activities, including timber harvests and use of prescribed fire. Other research data and literature is cited throughout the report.

When predicting fire behavior, the following factors are considered:

(1) Fuel Model, which considers fuel loading to be the primary indicator of fire intensity.

(2) Arrangement of fuels. Aspect and topography, including steepness of slope, are included here, as well as stand composition by age/size class. This is an indicator of the stand's susceptibility to crown fire initiation and propagation.

(3) Weather factors. Temperature and Relative Humidity and the resulting 1-hour (fine) fuel moisture. Wind speed and direction.

Of these factors project activities are expected to affect only fuel model/loading and arrangement.

Models used in Effects Analysis

<u>Fire and Fuels Extension of the Forest Vegetation Simulator (FFE-FVS)</u>

The Forest Vegetation Simulator (FVS), which is widely used by forest managers throughout the United States and Canada to predict the effects of various vegetation management actions on future forest conditions, was used for this analysis. The Fire and Fuels Extension to FVS (FFE-FVS) integrates FVS with elements from existing models of fire behavior and fire severity. Model output displays fuels, stand structure, snags, and potential fire behavior over time and provides a basis for comparing proposed fuel treatments (Reinhardt and Crookston 2003, p. 12).

FFE-FVS; North Idaho Inland Empire regional variant revised 11/02/15, was used in this analysis. Site-specific data gathered from field exams was used in the FFE-FVS model. 90^{th} percentile weather for the last 15 fire seasons: May 10^{th}-October 10th, 2003-2018, was obtained from the Fishhook RAWS station (PF#8). The weather station is approximately 3 miles SW of the Brebner Flat project area. Scenarios were run for a potential wildfire in the Brebner Flat project area under No Action conditions and Proposed Action conditions, using planned prescriptions for silviculture and fuels. Stands representing the following treatments were modelled: 1. Clearcut with reserves/Broadcast burn, 2. Seedtree with reserves/Broadcast burn, and, 3. Irregular Shelterwood with reserves/Grapple pile and burn. Output was analyzed and the results charted for comparison.

FFE-FVS was used to assess the risk of fire to a stand with indicators such as potential flame length, the probability of torching, and the critical wind speeds required to initiate and sustain a crown fire. This model is not intended to predict the probability of fire or the spread of fire between stands (Reinhardt and Crookston 2003, p. 12). It is used solely to assess the potential fire behavior and fire effects possible considering current and future stand conditions with typical fire season weather.

Spatial and Temporal Context for Effects Analysis

The fire/fuels analysis is completed at different scales. The project area is used in the analysis for cumulative effects for fire (past, present, and reasonably foreseeable). Stand-level fire behavior indicators are used to portray the direct, local effects of vegetative treatments on fire and fuel characteristics, and are reported at the stand level. These stand-level effects are modeled for 80 years into the future, giving a picture of the life cycle of the stand. Confidence in modeled outputs declines substantially beyond 100 years primarily due to accumulation of assumptions and unknowns.

Connected Actions, Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

Activities that are relevant to the cumulative effects analysis for the Fire/Fuels resource are those that modify fuels and vegetation, or have the potential to affect fires and fire behavior across the analysis area. Timber harvest, pre-commercial thinning, and other stand improvement activities affect stand structure, species composition and fuel loading and are included in this analysis. Fire management activities such as prescribed burning and wildfire suppression, as well as past wildfires are also important in assessing cumulative effects. Past and present road construction can be a barrier to fire spread and therefore is also relevant in this analysis. Activities which could contribute to human fire starts are considered, even though few wildfires have been recorded in the area in recent history, and most have been caused by lightning. Recreational activities, use of motorized vehicles, outfitter/guide permits, and firewood gathering are not expected to have much of an effect on wildfire starts or fire behavior for this project. Activities such as road and trail maintenance of established routes, weed treatments, mineral exploration, in-stream projects, and culvert modification or replacement do not affect the fire/fuels resource and are not relevant to the cumulative effects analysis. They have been left off the following table.

Table 2. Consideration of Past, Present, and Reasonably Foreseeable Activities for Cumulative Effects

Action	Past	Present	Future	May Have Cumulative Effects	Explanation
Timber Harvest	X	X	X	Yes	Past management activity served to reduce fuel loadings and diversify landscape, both effects carry forward.
Tree Planting	X	X	X	Yes	Past management activity served to restore fire-resilient species to landscape.
Precommercial Timber Stand Improvement	X	X	X	Yes	Past management activity served to reduce fuel loadings and diversify landscape, both effects carry forward.
Mechanical or Manual Site Preparation & Fuels Treatment	X	X	X	Yes	Past management activity served to reduce fuel loadings and diversify landscape, both effects carry forward.
Prescribed Burning for Site Preparation & Fuels Treatment	X	X	X	Yes	Past management activity served to reduce fuel loadings and diversify landscape, both effects carry forward.
Wildfires	X		unknown	Yes	Large wildfires helped to reduce fuel loading and diversify landscape.
Fire Suppression	X	X	X	Yes	Continued fire suppression serves to delay inevitable large fire events by contributing to fuel buildup and stand density.
Clearing Brush & Trees to	X	X	X	NO	

Action	Past	Present	Future	May Have Cumulative Effects	Explanation
Maintain Helispots					
Road Construction	X			NO	
Road Decommission-ing	X			Yes	May increase cost of fire suppression and final fire sizes by increasing response times.
Road Maintenance	X	X	X	NO	
Public Activities: recreation, firewood and Christmas tree cutting, berry picking, etc.	X	X	X	NO	
Outfitter and Guide Uses	X	X	X	NO	

Alternative A – No Action

Direct and Indirect Effects

Direct effects are those that are caused by the action and occur at the same place and time. No activities are proposed with the no-action alternative, thus there are no direct effects.

Indirect effects are caused by the action, but at a later time and/or removed in distance from the action. With no timber harvest or prescribed fire, stands would continue to accelerate towards late seral, shade tolerant tree species that are highly susceptible to insects and disease and fire. Mortality from insects and disease in the overstory favors grand fir and Douglas-fir regeneration, which leads to lower canopy base height. Combined with higher fuel loads from dead and down trees this structure is more conducive to high-severity fire. Over time, fuel loadings are expected to increase within the project area due to succession, root rot, and other disturbance factors.

Results of modeling the stands in FVS support this (PF#16-19). **Figures 8-13** show how a potential fire in the project area is expected to behave. No Action and Action alternatives were graphed for three stands, a clearcut, a shelterwood, and a seedtree.

Surface Flame Lengths in the stand slated to be clearcut with reserves (Figure 8) are modelled from present to the year 2090 at 9 feet and greater. This is well over the 4-foot flame length threshold where a fire can be attacked effectively by hand crews using direct tactics. Fires with higher flame lengths require indirect tactics, making fires larger. They may also require equipment such as dozers and engines, and aircraft. Higher surface flame lengths, combined with lower canopy heights and bulkier tree canopies, contribute to torching and crowning. These types of fires are typically more difficult and dangerous to suppress and result in more tree mortality than fires that do not torch and burn in the crowns. Figure 9 shows predicted flame lengths for the seedtree and shelterwood stands if left untreated. These two stands are presently healthier than the clearcut stand, and would produce flames between 3-4 feet and rising steadily until 2030, when flames surpass the four foot mark in both.

With no management action in the clearcut stand, **probability of torching** (Figure 10) holds steady between an 80-100% chance that torching will occur somewhere in the stand if a wildfire occurs. For the seedtree and shelterwood stands probability of torching generally increases into the future, but is more variable (Figure 11). This is because of different stand conditions, including high canopy base heights in the shelterwood stand (16-26 feet), probably due to more western larch existing in the stand. The lower boles of mature western larch generally do not have branches.

The **crowning index** charted in Figure 12 and Figure 13 indicates that crowning could occur more readily and at significantly lower wind speeds under the no-action alternative than with the any of the three proposed treatments. A lower number in the crowing index indicates higher crown fuel loadings and a higher crown fire hazard (crowning can occur at lower wind speeds). Crown fires are almost always stand-replacing, and are more dangerous and costly to suppress.

Road access for fire suppression would not be affected relative to present levels of access.

Cumulative Effects

Cumulative effects result from the incremental impact of the proposed action when added to impacts from past, present, and reasonably foreseeable future actions. Past actions contribute to the existing condition, and are discussed in the fire history and vegetative conditions sections of this report.

Presently, pre-commercial timber stand improvements (TSI) are continuing to take place in stands that were harvested and planted in the Kelley Creek, Blue Grouse, and Bonehead Sisters timber sales in the 1990's. TSI activities consist primarily of pruning lower branches of white pine trees (to help protect them from blister rust), and thinning around desirable species in overstocked stands to prevent stagnation and increase growth. Slash created by such activities is typically treated using a lop and scatter method, cutting and spreading branches to a depth of no more than 18 inches to reduce fuel concentrations until natural decomposition occurs. As of 2015, there were still about 600 acres of TSI in the Brebner Flat project area, some of which has been accomplished in the last four years.

The underlying assumption of this analysis is that wildfires would continue to occur into the future in the project area. It is expected that suppression will be the fire management course of action preferred due to the proximity of the town of Avery and the timber values in the area, including the investment in stand development with this project. If history continues to repeat itself we can expect the majority of fires to be lightning-caused; however if public use increases there could be an increase in human-caused fires. It is impossible to know where or when these fires will occur.

Fire exclusion causes forest composition to change from early-seral, shade-intolerant tree species to late-seral, shade-tolerant species, while stand structure changes from single-layer to multiple-layer canopies. An important stand characteristic that changes with advancing succession in the absence of fire is the amount of dead and live biomass or fuels, which tend to increase (Keene and others, 2002). Without the fuel treatments proposed in Alternative B, the stands in the project area can be expected to trend in this direction, making fires increasingly difficult to suppress.

Alternative B – Proposed Action

The proposed action in Alternative B consists of tree harvest with reserves on 1719 acres. Prescribed fire would be utilized, where appropriate, in these units to manage accumulations of slash produced by the harvest activity and to prepare the sites for planting of desired species. Treatments are listed by unit in the project file (PF#15). Design features guiding slash treatment and prescribed burning are discussed in the next section of this report.

Direct and Indirect Effects

Fuel management activities in Alternative B promote a desired condition where potential flame lengths and fire intensities decrease due to removal of fuels through timber harvest and burning. These activities directly affect the amount and availability of fuels in the event of a wildfire. Reduced flame lengths, probability of torching, and crowning index allow for more options in fire management and increased firefighter safety during fire suppression activities.

With the introduction of more seral species after harvest, Alternative B increases heterogeneity in the stands. The slash created from harvest in Alternative B would probably increase fire behavior if a wildfire were to start in the area prior to slash treatment, but design features and compliance with the Idaho Forest Practices Act would hasten treatment of slash and planting of trees that are more resistant to disease and fire than current conditions. Timely slash treatment, aided by a schedule of logging that allows areas of the sale(s) to become available for fuels work as soon as possible after harvest, as well as keeping temporary roads open until after fuels work is done, is crucial to meeting the fuels reduction objectives of this project.

For the sake of all simulations for Alternative B, harvest was scheduled for 2021, with immediate slash treatment of whole tree yarding and piling. Burning of piles and broadcast burning was accomplished within two years of harvest, and tree planting of western larch was completed in 2023. It was assumed that by 2045 (24 years post-harvest), fuel loading in stands would resemble a fuel model “TL3”, or a moderate load conifer litter. TL3 has a low flame length and a very low spread rate (Scott and Burgen, 2005). By 2069, the stands would be nearing maturity and fuel loads and fire behavior would slowly increase as trees died and fell to the ground, modelled by a “TL5”. TL5 is a high load conifer litter, with light slash or mortality fuel.

Referring back to flame lengths in Figures 8 and 9, the action alternative for all three treatment types results in flame lengths at or below the 4-foot threshold. The proposed timber harvests followed by fuel reduction would result in a short-term, substantial decrease in ladder fuels. Ladder fuels increase again as trees grow prior to pruning, either naturally or mechanically. As ladder fuels decrease, surface fuels increase. Flame lengths in all scenarios increase towards the 4-foot mark in the 10-20 years after planting, before lowering again as the stand grows.

This same cycle is reflected in the trends for probability of torching and crowning index (Figures 10-13). Around the year 2042, when the stand is about 20 years old, both indices peak and then drop again. Young trees in the stands are susceptible to torching and crowning due to their size. The distance from the ground to the base of the crowns is small and surface fuels can reach them easier. As soon as crown base heights increase, the probability of torching again decreases.

With shorter surface flame lengths and less probability of torching, crowning index also predicts moderated fire behavior with the Action Alternative for many years into the future. All three examples show a reduced likelihood of crown fire than with the No Action Alternative.

It is reasonable to expect follow up timber stand improvement activities as the stands in Brebner Flat regenerate. Pre-commercial thinning and pruning are expected to have the same type of short-term effects to fuel loading as they have in the past. Namely, there would be increased slash adding to the fuel loading in small areas across the landscape for 3 to 5 years until decomposition occurs.

In addition to the silvicultural treatments proposed in this alternative, road construction and re-construction is proposed. Changes to road prescriptions are also proposed (PF#14, Brebner TAP Report, dated 1/20/2017). The Brebner Flat area is designated in the Forest Plan as suitable for timber production. What this means for fire management is that this is an area where wildfires would most likely be suppressed due to the risk to timber with a commercial value. Additions to the road system and maintenance of existing roads make this safer and more efficient by allowing access for suppression efforts and by the roads themselves acting as fuel breaks.

Under Alternative B, roads 390G and 3468 would be kept available for administrative use. These roads were both ranked as important to the fire resource as they access large areas, including high points that can be used as lookout points or helispots. Where these roads travel along or near ridgetops, they can be good places to make a stand against a wildfire by serving as fuel breaks.

Forest road 1248 in the project area will remain open, but only until burning and planting activities associated with Brebner Alternative B are complete, at which time it goes into long-term storage. What that means is that the road will be closed by either a permanent barrier or by re-contouring the beginning of the road (i.e. front end obliterate). Activities for these roads may include surface de-compaction, culvert removal, re-establishment of stream channels, and re-vegetation within the road corridor. In other words, it will not be drivable by fire-fighting vehicles. Fire suppression response would thus be slowed in this area. However, proposed road decommissioning would reduce the potential for roadside human-caused ignitions by reducing accessibility. All other roads in the project area scheduled for reduced access as part of Alternative B have been deemed not useful to fire. They are either completely grown in or provide redundant access for fire suppression due to other roads in the area.

Cumulative Effects

Past, present, and reasonably foreseeable activities remain the same under this alternative as they are under Alternative A.

Design Features and Mitigation Measures

The purpose of the design features for the fire/fuels resource is to ensure that fire management activities related to the action alternatives have a high probability of success in meeting the silvicultural, air quality, and fuels objectives, as well as being implemented in a safe and efficient manner.

1. Directional felling (into the interior of the units) would be used to minimize the amount of activity fuels along unit boundaries.

2. To reduce fuel loading, tops and limbs would be yarded in harvest units where soil conditions allow.

3. Slash pullback, concurrent with harvest, would be done to minimize slash outside of the unit.

4. Slash piles should be constructed free of stumps, soil, snow, and non-woody organic material, and should be burned as dry as practical to enhance efficient combustion.

5. Prescribed burning may occur at any time of year, as prescription parameters, burn windows, and smoke emissions restrictions permit.

6. All burning activities would be conducted according to the requirements of the Montana/ Idaho Smoke Management Unit guidelines outlined in the Montana/Idaho Airshed Group Operating Guide (2010).

7. Where prescribed fire is used as a treatment method, firelines and /or fuelbreaks would be constructed as needed, and as determined by fire managers. Topographic and vegetative features of the landscape may also be used for containment of prescribed fires when possible.

8. Schedule of logging will be such that coordination between harvest, burning, and road closure will be timely and efficient. In order to accomplish proposed prescribed burn activities and achieve site preparation requirements most-effectively, logging operations at all units should be completed in such a way that allows them to be released for slash treatment as soon as possible after harvest, and before roads are stored or decommissioned.

Table 3. Risk Factors and Risk Level With and Without Design Features

Factor	Risk Level *without* Design Features	Risk Level *with* Design Features
Landing or Grapple pile burn escapes	Low. Pile burning generally occurs late in the season after recent moisture has precipitated on the outside of piles and surrounding fuels.	Low. With directional felling minimizing material along unit boundaries, and with piles being lit under appropriate weather conditions, risk of escape is low. (DFs #1, #3)
Smoke from landing pile burning creates hazard along open routes	Moderate. Pile burning generally occurs late in the season and may overlap with hunting season.	Low. When piles are constructed cleanly and burned as dry as possible, combustion is fairly efficient, minimizing smoke generation. Piles are burned according to requirements of MT/ID SMU when weather conditions for dispersal are acceptable. (DFs #4, #5, #6)
Wildfire spreads from outside of unit to within unit, or vice versa	High. Without treating activity slash, expected rates of spread post-harvest would be moderate to high, moving quickly through activity slash.	Low. Slash treatments include yarding limbs and tops to landings and burning/removing landings, spot grapple piling, directionally felling along boundaries, as well as prescribed burning. These treatments would isolate and disrupt fuel continuity generated through harvest, and provide effective breaks to fire spread. (DFs #1, 2, 3, 7)
Prescribed fire spreads from within unit to outside unit	High. Fire spread would be difficult to contain without firelines and/or fuelbreaks where fuels are continuous.	Low-Moderate. Containment lines would serve to disrupt fuel continuity and keep prescribed fire within desired areas. (DFs #5, #7)
Slash from harvest not treated in a timely fashion	High. Slash hazard generated from harvest activities would not be reduced and could present a higher risk for fire spread as well as increase resistance to control. Additionally, implementation costs could also increase.	Low-Moderate. A coordinated schedule of logging would encourage organized harvest operations so units could be released and slash hazard and site preparation activities completed in a timely fashion so that slash hazard can be addressed. (DF #8)

Air Quality

The air quality in and around the Brebner Flat project area is generally good throughout the year, due to good air dispersion (i.e., air pollution causes little or no health and safety risk); however, human-caused and natural events inside and outside the project area do occasionally affect air quality. Human influences include campfires, vehicle exhaust, dust from equipment and vehicular travel, and smoke from agricultural and forest slash burning. Effects from these sources are localized and short-term. Natural events such as dust storms and wildland fire events also contribute to reduced air quality at times.

Prevailing winds are generally from the southwest, causing smoke to be dispersed to the northeast. Spring and early summer seasons typically have good dispersion and atmospheric mixing conditions. Daytime heating lifts smoke up into the atmosphere and mixing winds disperse smoke downwind. Dispersion can be problematic under stable high-pressure systems, and prescribed burns are generally avoided under these predicted conditions. Inversions are not uncommon especially in cold winter months. Prescribed fire smoke, if not dispersed, can become subject to nighttime downslope winds, become trapped by nighttime inversion conditions, and contribute to valley smoke pooling until the next period of daytime heating. Fires exposed to free air wind tend to have better dispersal than fires located in sheltered areas or in valley bottoms.

Where burning is proposed as part of action Alternative B, design features would ensure attention to smoke management, including coordination with the Montana/Idaho Airshed Group. In addition to burning when dispersion is good, smoke management techniques include reducing the amount of fuel consumed, burning before new fuels appear, and increasing combustion efficiency.

Burning when large-diameter woody fuels (i.e., ≥ 3” diameter) have a high enough fuel moisture to not sustain combustion would reduce smoldering, while still meeting objectives of eliminating fuels of the smaller size classes that contribute to the spread of fire. These larger logs also provide desirable micro-climate sites for planting new trees if left unburned. Burning before green up can produce fewer emissions. Backing fires cause more combustion to take place in the flaming phase than the smoldering phase. This common technique aids in controlling the spread of the fire and minimizing impact to leave trees, as well as smoke management.

Because of potential health effects, the major emissions of concern in smoke from wildland fire are particulate matter of 10 microns or smaller and 2.5 microns or smaller in diameter (PM 10 and PM 2.5), and carbon monoxide. The BlueSky Playground web tool (http://www.airfire.org/data/playground/) estimates pollutant emissions and predicts downwind smoke concentrations from wildland fire. Inputs for modeling scenarios include location, number of acres, and fuel loadings based on fuel models from the Fuels Characteristic Classification System (FCCS). Fuel moisture conditions can be varied from very dry to very wet depending on seasonal conditions at the time of ignition. Consumption results are generated from the CONSUME model and are broken into flaming, smoldering, and residual fuel consumption in tons/acre. Emissions are modeled with the FEPS model.

Scenarios were run for both types of burning (broadcast burning of activity fuels and burning of machine piles) proposed for Brebner Flat under average prescribed fuel moisture conditions that would be used to meet objectives (PF#10). Broadcast burning of activity fuels in harvest units, consisting of lodgepole pine, grand fir and Douglas-fir, would be burned under moderate conditions. Pile burns for machine piles at landings and in units where slope and soil conditions allow would be burned under moist conditions. The wildfire scenario was modeled under dry conditions typical for summer fire season to represent potential wildfire emissions under the No Action alternative (PF#9). Table 4 shows the estimated emissions under each scenario as described above.

Table 4. Estimated PM2.5, PM10 and CO Emissions

Scenario	Fuelbed	Fuel Moisture/Pile Conditions	Total Tons $PM_{2.5}$	Total Tons PM_{10}	Total Tons CO

Scenario	Fuelbed	Fuel Moisture/Pile Conditions	Total Tons $PM_{2.5}$	Total Tons PM_{10}	Total Tons CO
Wildfire--1800 acres over 3 days	Douglas-fir/ grand fir (FCCS #208)	Dry: 10 hr-8% 1000 hr-12% Duff-40%	1415.73	1670.56	17,081.60
Broadcast Burn—1271 acres	Custom fuel loading*	Moderate: 10 hr-9% 1000 hr-15% Duff-70%	490.41	578.68	5585.18
Pile Burn—5000 piles	Douglas-fir/ lodgepole/grand fir	Dirty Piles: 0-10% soil Machine-piled 10'x10'x10'	51.85	61.00	230.55

*Taken from Photographic Series: Appraising Slash Hazard in ID. P.55, LP cover type w/ DF after a partial cut.

The model shows that greater amounts of particulate matter and carbon monoxide would be generated in a wildfire event than through proposed prescribed fire activities.

The Clean Air Act, passed in 1963 and amended in 1977, 1990, 1999 (42 USC 7401-7626) provides the framework for national, state, and local efforts to protect air quality. North Idaho joined the Montana/Idaho State Airshed Group in 1990 in response to the Idaho State Implementation Plan. This group cooperates with both Idaho and Montana Departments of Environmental Quality to coordinate all prescribed burning activities, provide smoke forecasting, and establish air quality restrictions for Group members. This is done in order to minimize or prevent impacts from smoke emissions and ensure compliance with the National Ambient Air Quality Standards (NAAQS) issued by the Environmental Protection Agency (EPA), the federal agency charged with enforcing the Clean Air Act. The USDA Forest Service, including the St. Joe Ranger District, is a member of this Airshed Group through the North Idaho Memorandum of Agreement and adheres to the North Idaho Smoke Management Plan and the Montana/Idaho Airshed Group Operating Guide (2010). The Brebner Flat project area is in North Idaho Airshed Unit 12B.

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Forest Service Manual (FSM) 5100-Fire Management: Provides authority for fire management on Forest Service Lands. The primary criteria for choosing fire suppression strategies and tactics are to ensure the safety of the public and firefighting resources while minimizing suppression costs, resource loss, environmental damage, and the threat of wildland fire escaping onto non-Federal lands (FSM 5130.3). Direction is provided on mitigating hazardous fuels and using fire to achieve desired landscape conditions and attain Land and Resource Management Plan objectives in FSM 5140.

The Action Alternative (Alt. B) is consistent with the objectives of fire management as described by FSM 5140. The No Action Alternative (A) does nothing to mitigate hazardous fuels or to use fire to achieve desired landscape conditions.

Idaho Forestry Act, Fire Hazard Reduction Law, Title 38, Chapters 1 and 4: Contains rules and regulations pertaining to management of fuels and debris resulting from a forest practice involving removal of a commercial product in the state of Idaho.

This Act only has relevance to Alternative B where timber harvest is proposed. Standard logging practices, such as yarding tops and creating piles where slash can be burned under desired conditions, along with other design features listed in this document, comply with the Idaho Forestry Act.

Land Management Plan, Idaho Panhandle National Forests, 2015 (IPNF 2015 Forest Plan): The 2015 Forest Plan provides guidance for project-level analysis. Desired conditions, objectives, and guidelines for the fire and fuels portion of the Brebner Flat project are discussed below:

FW-DC-FIRE-01: Public and firefighter safety is always recognized as the first priority for all fire management activities.

The Action Alternative (Alt. B) takes steps to reduce fuels and improve resiliency of stands in the project area, which is expected to result in reduced fire behavior and more opportunities for safe and effective fire management. Alternative A does nothing to improve the safety of firefighters or the public.

FW-DC-FIRE-02: Hazardous fuels are reduced within the WUI and other areas where values are at risk. Fire behavior characteristics and fuel conditions exist in these areas that allow for safe and effective fire management. Fire behavior is characterized by low-intensity surface fires with limited crown fire potential. Forest conditions, and the pattern of conditions across the landscape, exist in these areas such that the risk is low for epidemic levels of bark beetles, high levels of root disease, and large scale, stand replacement wildfires.

Alternative A takes no action towards this desired condition. The logging and prescribed fire activities in the action alternative would reduce fuels, some of which are in the WUI. The action alternative also address the root disease that is prevalent in many of the stands.

GA-DC-FIRE- SJ-01: Fire hazard is reduced within the defensible space for rural communities in the St. Joe GA. Hazardous fuels are reduced in the lower St. Maries River zone within the WUI, as well as evacuation corridors along the St. Joe River and Gold Pass.

Alternative B ultimately reduces fuels in the Avery WUI through timber harvest and removal and burning of remaining activity fuels. Future, more-seral, stands resulting from activities in the proposed action will be more resilient to fire and insect and disease-related disturbances and climate change. Alternative A does not reduce fuels in the WUI.

FW-OBJ-FIRE-01: The outcome is the treatment of fuels on approximately 6,000 to 16,000 acres annually on NFS lands, primarily through planned ignitions, mechanical vegetation treatments, and unplanned ignitions. NFS lands within the WUI are the highest priority for fuel treatment activities.

Alternative B would mechanically treat vegetation on about 1800 acres. The action alternative would contribute to this fuels treatment objective in the forest plan.

MA6-GDL-FIRE-01: Fuels are reduced, particularly within the wildland urban interface, to reduce the threat of wildland fire.

This guideline from the forest plan is being followed based on the above discussions of plan objectives and desired conditions.

Clean Air Act: Current direction to protect and improve air quality on National Forests is provided by: The Forest and Rangeland Renewable Resources Act of 1974 (16 U.S.C. 1601), as amended by the National Forest Management Act (16 U.S.C. 1602); 2); The Federal Land Management Policy Act of 1976 (43 U.S.C. 1701); and 3) The Clean Air Act amendments of 1977 and 1990 (42 U.S.C. 7401-7626).

Any prescribed burning associated with this project will comply with the Clean Air Act through coordination with the Montana/Idaho Airshed Group as described in the Air Quality section of this report.

Summary of Effects

Alternative A: No Action

Beneficial fuel management activities would not take place in the project area with this alternative. The purpose and need to improve resilience and reduce hazardous fuels in the long term would not be met. With no action there would be no reduction in fire behavior as indicated by flame lengths, probability of torching, and crowning index. Over time the accumulation of fuels due to succession and the potential increase in crown fire activity could lead to larger fires that are harder to control. This would be accelerated by mortality caused by the root rot and other pathogens already established in the stands that would go untreated. Uncontrolled fire in the Wildland Urban Interface could threaten structures and lives. Crown fires would be more destructive to the commercial timber in the area.

In the unlikely, but possible, event of a wildfire of similar size as the proposed treatments (1800 acres), emissions from smoke are expected to be more than double emissions from all the prescribed fire treatments in Alternative B combined.

Alternative B: Proposed Action

Alternative B works toward the Forest Plan desired condition for firefighter and public safety by reducing expected fire behavior through reduction and rearrangement of fuels (changing the fuel model). Fuel treatments would reduce ladder fuels, which would reduce probability of torching and chance of crown fires. Air quality would be adversely affected for short periods of time as portions of the proposed prescribed burning are implemented, but the impact to the airshed has been shown to be minimal compared to wildfire impacts on air quality. Improvements and additions to the existing road system would provide fuel breaks and more efficient and safer access to the area for fire fighters.

Monitoring Recommendations

The monitoring program in the IPNF Forest Plan provides the feedback for the forest planning cycle by testing assumptions, tracking relevant conditions over time, measuring management effectiveness, and evaluating effects of management practices. In order to assess to what extent management activities are moving hazardous fuels towards desired conditions, acres of hazardous fuel treatments within the WUI and outside the WUI are to be reported annually. This is not intended to depict all monitoring, inventorying, and data gathering activities undertaken on the Forest. Additional protocol for monitoring of fire and fuels related activities are as follows:

1. Pre-and post-treatment monitoring of activity fuels units burned for the purpose of fuels reduction and site-preparation on timber harvest units.

2. Post-burn monitoring as part of each prescribed fire burn plan to include fire behavior, smoke, and fire effects.

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